Near-side $\Delta\eta$ correlations of high-p_t hadrons from STAR

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Abstract. Systematic measurements of pseudorapidity ($\Delta\eta$) and azimuthal ($\Delta\phi$) correlations between high-p_t charged hadrons and associated particles from the high statistics 200 GeV Au+Au and Cu+Cu datasets will be presented. In previous measurements differences in the near-side $\Delta\eta$ correlation between central Au+Au and the lighter systems d+Au and p+p were observed, including an additional long-range near-side correlation in Au+Au collisions. Studies to characterize the properties of the additional correlation will be presented.

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The observation of additional near-side long-range $\Delta\eta$ correlations for soft hadrons ($p_t < 2$ GeV) in Au+Au collisions was first noted in [1]. Similar effects were observed in [2, 3] but in a kinematic regime where parton fragmentation may play a significant role. In these proceedings the increased statistics in Au+Au and Cu+Cu will be used to show systematic studies of the correlated yield dependence on centrality and transverse momentum of the trigger ($p_{t,trigger}$) to characterize the properties of the long-range $\Delta\eta$ correlation.

To extract the correlated yield of the near-side long-range $\Delta\eta$ correlation (*ridge yield*) from dihadron correlation measurements, we take advantage of the η and ϕ acceptance of the STAR-TPC, by projecting the two dimensional ($\Delta\eta \times \Delta\phi$) correlation function onto $\Delta\phi$ and $\Delta\eta$ in different $\Delta\eta \times \Delta\phi$ regions after correcting for the finite $\Delta\eta$ pair acceptance. Three methods were used to characterize the short-range *jet-like* (J) and *ridge-like* (R) contributions to the near-side jet yield[2] in $\Delta\eta$ and $\Delta\phi$:

- $\Delta\phi(J+R)$ method: Projecting onto $\Delta\phi$ with the full experimental $\Delta\eta$ acceptance and subtracting the elliptic flow (v_2) modulated background.
- $\Delta\phi(J)$ method: Subtracting the $\Delta\phi$ projection for $|\Delta\eta| > 0.7$ from the $\Delta\phi$ projection around the near-side jet-like correlation ($|\Delta\eta| \leq 0.7$). The flow modulated background and the ridge-like correlations are thereby removed (under the assumption that the ridge-like correlation is uniform in the STAR $\Delta\eta$ acceptance).
- $\Delta\eta(J)$ method: Projecting onto $\Delta\eta$ in a $\Delta\phi$ window around the near-side jet-like correlation. Under the assumption that the ridge-like correlation is uniform

[1] For the full list of authors see [1].
[2] The near-side yield is defined as the integral of a gaussian fit to the $\Delta\phi$, $\Delta\eta$ correlation functions.

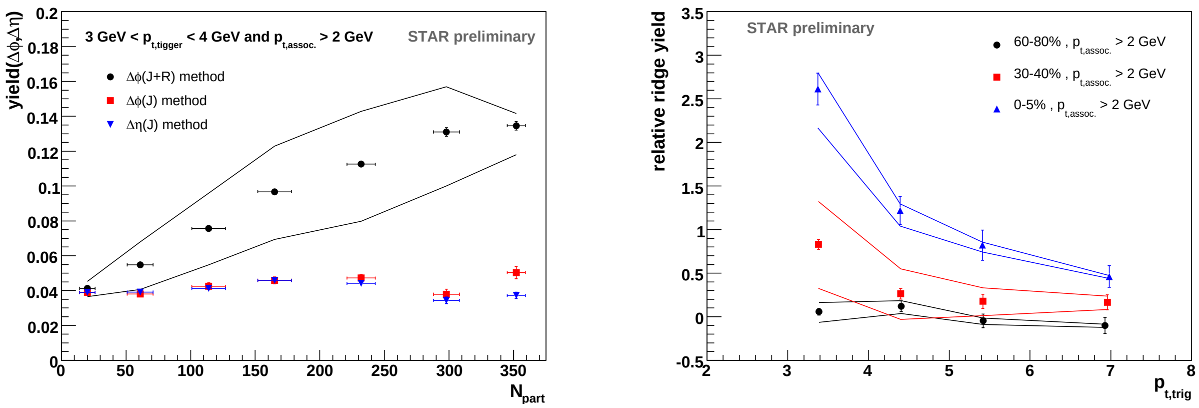

FIGURE 1. a) Near-side yield as a function of N_{part} in Au+Au. b) Relative ridge yield for different centralities as a function of $p_{t,trigger}$ for $p_{t,assoc.}$ > 2 GeV in Au+Au. The lines represent the systematic error due to uncertainties in the elliptic flow measurements.

in the STAR-TPC $\Delta\eta$ acceptance subtracting the measured constant background will remove the ridge-like contributions.

In Fig. 1 a) the near-side yield is shown as a function of N_{part} for all three methods. The agreement of the yields in the $\Delta\eta(J)$ and $\Delta\phi(J)$ methods and their independence of centrality for fixed $p_{t,trigger}$ and $p_{t,assoc.}$supports the assumption of a jet-like origin. In contrast the $\Delta\phi(J+R)$ method shows a significant increase of the near-side yield with centrality due to the inclusion of the ridge-like correlations and one can define the (absolute) $ridge\ yield = yield(\Delta\phi(J+R)) - yield(\Delta\eta(J))$. By normalizing to the jet-like yield $\Delta\eta(J)$ the *relative ridge yield* contribution is obtained. By varying the $\Delta\eta$ projection window in the $\Delta\phi(J+R)$ method it was found that within the STAR $\Delta\eta$ acceptance the ridge is independent of $\Delta\eta$ (not shown). This supports the assumptions made in the $\Delta\phi(J)$ and $\Delta\eta(J)$ method to subtract the ridge yield contributions. The main systematic error is due to the uncertainty in the elliptic flow measurement for the $\Delta\phi(J+R)$ method. The v_2 values used in this analysis are: the mean of the reaction plane ($v_2\{RP\}$) and four-particle cumulant method ($v_2\{4\}$)[4] in Au+Au and the scalar product method $v_2\{CuCu-pp\}$ in Cu+Cu [5]. The systematic uncertainties were estimated using $v_2\{RP\}$ as maximum and $v_2\{4\}$ for Au+Au (v_2=0 for Cu+Cu) as minimum v_2 values (represented as lines in all figures).

The relative ridge yield for $p_{t,assoc.}$ > 2 GeV decreases strongly with increasing $p_{t,trigger}$ (Fig. 1 b)). A strong centrality dependence is also visible: the relative ridge yield decreases from a large contribution in central Au+Au to a negligible contribution in peripheral Au+Au collisions for the lowest $p_{t,trigger}$ bin. The most striking feature however is the observation that the (absolute) ridge yield is independent of $p_{t,trigger}$ for each centrality class, but increases with centrality as shown in Fig. 2 a). For higher $p_{t,assoc.}$ > 3 GeV (not shown) the (absolute) ridge yield is smaller but also independent of $p_{t,trigger}$ and still showing a similar centrality dependence.

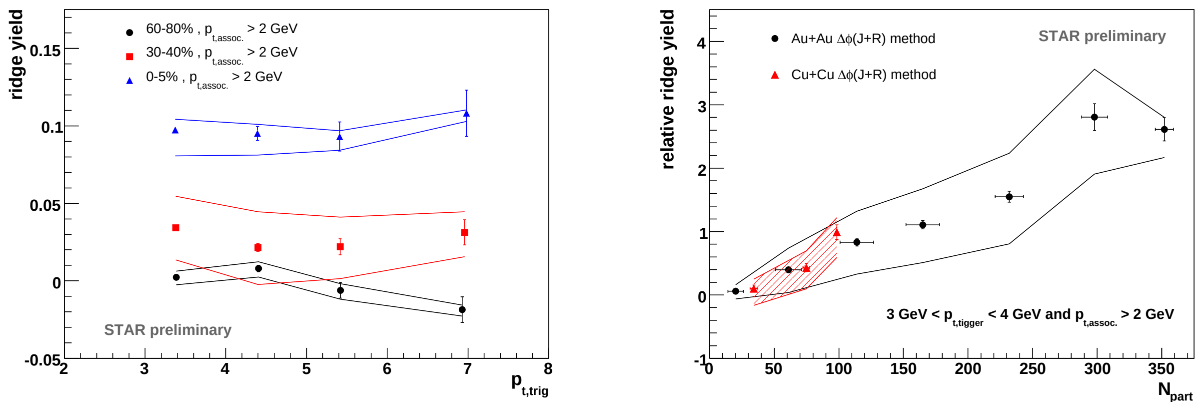

FIGURE 2. a) (Absolute) Ridge yield for different centralities as a function of $p_{t,trigger}$ for $p_{t,assoc.} > 2$ GeV in Au+Au. b) Centrality dependence of the relative ridge yield for Au+Au and Cu+Cu. The lines represent the systematic error due to uncertainties in the elliptic flow measurements.

In Fig. 2 b) the centrality dependence of the relative ridge yield in Au+Au compared with Cu+Cu collisions is shown. In the overlapping N_{part} region the relative ridge yield in Cu+Cu is consistent with Au+Au. This result is in agreement with the observed N_{part} scaling of the nuclear modification factor in Au+Au and Cu+Cu collisions [6] indicating that these effects could have the same origin.

The underlying physics of these effects are not quite clear yet, but the independence of the (absolute) ridge yield on $p_{t,trigger}$ is consistent with the picture where the ridge is caused by the coupling of induced radiation to longitudinal flow [7] with a radiation spectrum that is independent of the jet energy. Alternative approaches to describe these phenomena are based on a combination of jet-quenching and strong radial flow [8] or on recombination of thermal partons in the recombination framework [9]. To distinguish between these models measurements with an increased $p_{t,assoc.}$ threshold as well as with identified associated particle will be persuaded. The influence of the different geometries in Au+Au and Cu+Cu could be tested by a reaction plane dependent analysis. Quantitative theoretical calculations are needed to understand the origin of the ridge yield.

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